

# **Sleep and Fatigue Issues in Continuous Operations: A Survey of U.S. Army Officers**

## **Abstract**

A group of 49 US Army Officers recently returned from combat and attending the Infantry Officers Advanced Course at FT Benning, GA were surveyed to assess the sleep hygiene of their units and to determine the tactics, techniques, and procedures (TTPs) they used to reduce the effects of sleep deprivation in their units. Results indicate that despite Army policy, nearly 80% of the study participants had not received a sleep management plan during their most recent deployment. Over half (55%) of respondents reported that fatigue was a problem in their unit. The majority of respondents who received a sleep plan briefing indicated that their unit had done a good job of managing sleep routines (66% with vs. 25% without sleep plan briefing). Attention to the importance of sleep and fatigue management, manifested by sleep plan briefings, seems to be an important means by which units can mitigate fatigue in continuous combat operations. Respondents reported that during their most recent combat deployment, they spent nearly half (46.7%) of their time at high operational tempo (OPTEMPO). This factor becomes especially important when considering that survey respondents report receiving only four hours of sleep per day during periods when their units are at high OPTEMPO, just over half the amount the report when at low OPTEMPO (4.0 vs. 7.8 hours). The vast majority of respondents (82.6%) report feeling sleep-deprived occasionally, sometimes or all the time while they are at high OPTEMPO.

## **1. Introduction**

The demands of modern-day life contribute to work schedules whereby humans chronically fail to get adequate amounts of nightly sleep (Dement, 2000). Over the past century, research indicates that Americans get significantly less sleep than our forbearers, on average over 2 hours less per night. This alarming trend is even more prevalent among professions requiring round-the-clock operations such as emergency response teams and the military. Professionals in these fields are faced with both acute and chronic sleep deprivation, resulting in a sleep debt that undoubtedly affects their performance and safety. Cutbacks in military spending—and the desire to do more with less—have led to increasing pressure for military personnel to work longer hours with less time off. This pressure has led to longer work hours and fewer personnel, leaving less back-up coverage for those left in the positions. This problem is further exacerbated by the dangerous combat environments and poor sleeping conditions faced by members of the US military engaged in military operations.

The effects of sleep deprivation on performance are well documented in the scientific literature (Belenky et al., 2003; Van Dongen, Maislin, Mullington, & Dinges, 2003). In fact, the performance degradation from sleep deprivation has been likened to that

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>2009</b>	2. REPORT TYPE		3. DATES COVERED <b>00-00-2009 to 00-00-2009</b>		
4. TITLE AND SUBTITLE <b>Sleep and Fatigue Issues in Continuous Operations: A Survey of U.S. Army Officers</b>			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Naval Postgraduate School, Operations Research Department, Monterey, CA, 93943</b>			8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>In review</b>					
14. ABSTRACT <b>A group of 49 US Army Officers recently returned from combat and attending the Infantry Officers Advanced Course at FT Benning, GA were surveyed to assess the sleep hygiene of their units and to determine the tactics, techniques, and procedures (TTPs) they used to reduce the effects of sleep deprivation in their units. Results indicate that despite Army policy, nearly 80% of the study participants had not received a sleep management plan during their most recent deployment. Over half (55%) of respondents reported that fatigue was a problem in their unit. The majority of respondents who received a sleep plan briefing indicated that their unit had done a good job of managing sleep routines (66% with vs. 25% without sleep plan briefing). Attention to the importance of sleep and fatigue management, manifested by sleep plan briefings, seems to be an important means by which units can mitigate fatigue in continuous combat operations. Respondents reported that during their most recent combat deployment, they spent nearly half (46.7%) of their time at high operational tempo (OPTEMPO). This factor becomes especially important when considering that survey respondents report receiving only four hours of sleep per day during periods when their units are at high OPTEMPO, just over half the amount the report when at low OPTEMPO (4.0 vs. 7.8 hours). The vast majority of respondents (82.6%) report feeling sleep-deprived occasionally, sometimes or all the time while they are at high OPTEMPO.</b>					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>14</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			



experienced by alcohol intoxication (Dawson & Reid, 1997). In particular, vigilance performance is dramatically altered when sleep is restricted. Vigilance is crucial for many standard military tasks including watchstanding and tactical operations. When vigilance is degraded, important information is invariably missed, placing both service members and the mission at great risk.

Unfortunately, humans are not good at determining when our performance is impaired. The effects of fatigue are insidious and like all humans, military members are susceptible to fatigue. Tragically, there is an attitude prevalent among those in the military that may actually encourage stoic denial of the need for sleep (Shay, 1998). A study conducted at the National Training Center found that sleep decreased with rank, indicating that senior leadership received even less sleep than those junior to them (Belenky, 1997). Commanders and those individuals in supervisory roles may be even less able to identify their own sleep debt as well as that among their subordinates. They need strategies that will allow them to be effective at fatigue mitigation and they need guidance on fatigue countermeasures that can be followed easily.

This study addresses two issues: the reported sleep patterns of individual Soldiers and military units engaged in continuous operations; and the tactics, techniques, and procedures (TTPs) used by forward-deployed units to counter fatigue by managing their sleep and work cycles.

## **2. Method**

### **Participants**

Forty nine male United States Army Officers attending Infantry Officer Advanced Course at FT Benning, GA completed study questionnaires consisting of eight demographic and thirteen sleep hygiene questions. Two participants reported that they had never deployed to combat while one participant reported having deployed ten times in just six years of service. These three participants were excluded from further analysis. This paper focuses on the remaining 46 participants. The average age of the study population was 29.4 yrs (s.d.=4.4 yrs); six of the respondents held the rank of First Lieutenant (1LT), 38 were Captains (CPT), and two were Majors (MAJ). The average length of time in military service was 8.1 yrs (s.d.=5.0 yrs). The frequency of the number of combat deployments is shown in the Figure 1 with the percentage of the respondents shown by the number at the top of each bar. The majority of the participants (71.1%) had only one deployment to combat while the remainder had more than one combat deployment.

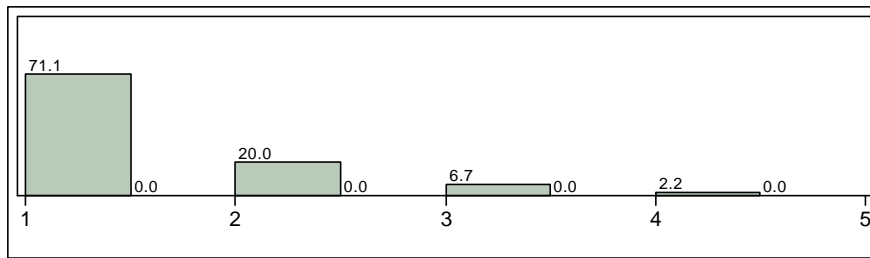


Figure 1: Frequency of combat deployments

On average, respondents reported that their total time they had deployed to combat was 15.5 months (s.d.=11.7 months).

### Procedures

The study protocol was approved by the Naval Postgraduate School (NPS) Institutional Review Board (IRB). Each participant provided written informed consent before participating in the study. All participants were asked to fill out the study questionnaire comprised of thirteen questions, three of which were open ended. Answers to the survey questions were entered into Excel. Statistical analysis was conducted with Microsoft Excel and JMP Release 7.0.

## 3. Results

Approximately 80% of the participants in the study reported that they were not briefed on a sleep management plan during their most recent deployment (*not briefed*: n=37, or 80.4%; *briefed*: n=9 or 19.6%). There was no correlation between whether or not the participant had been briefed and age, rank, length of total time in service, or length of commissioned service.

We also examined the extent to which the participants' units focused on sleep hygiene and on the use of countermeasures that could mitigate the impact of fatigue on individual and unit performance. We focused on participants' responses to four survey items:

- My unit worked in shifts (Item. (Survey item 3A))
- My unit encouraged and monitored naps (Item. (Survey item 3B))
- My unit designated dark and quiet areas for rest (Item. (Survey item 3C))
- My unit tried to enforce sleep schedules (Item. (Survey item 3D))

The frequency of responses to these four survey items is shown in Figure 2. The percentage of participants is shown by the number at the top of each bar. For example, in Figure 2, 25 percent of the total number of those responding to this item answered "Never" to Survey item 3A.

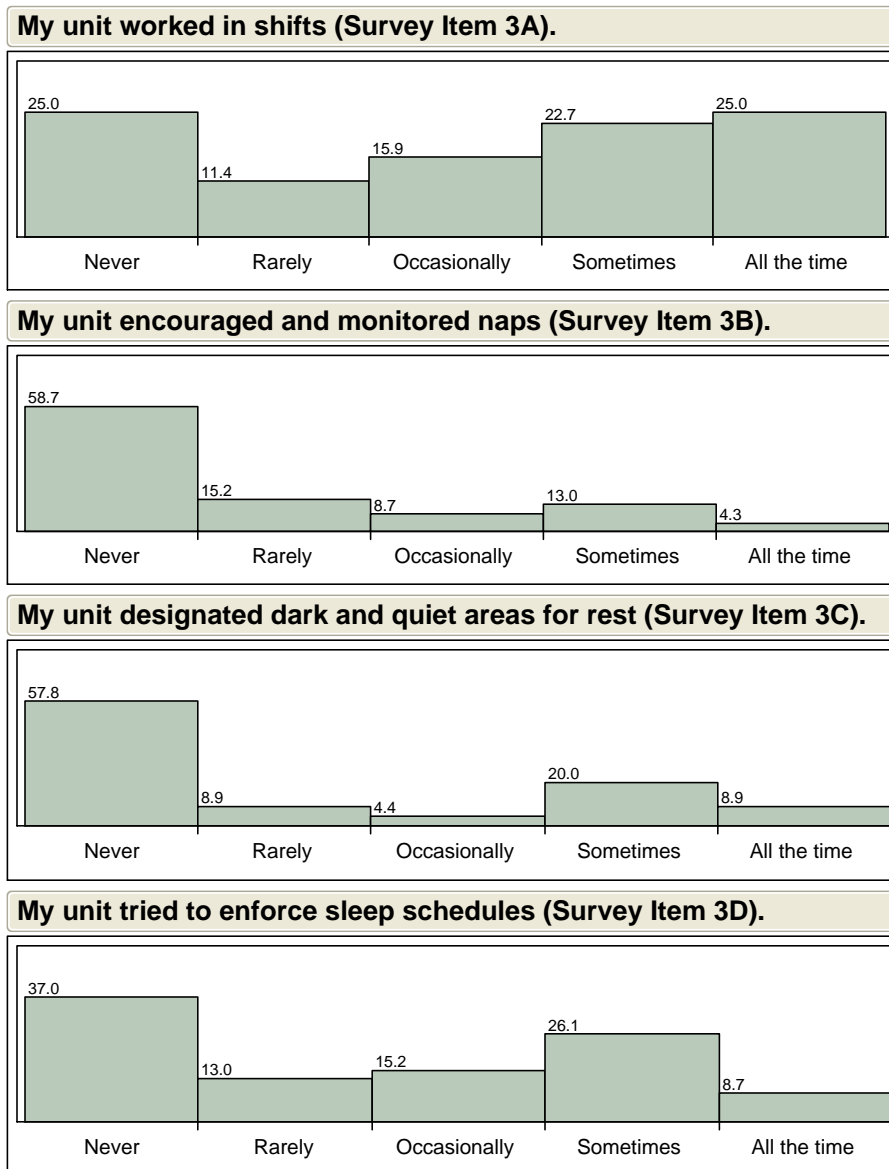


Figure 2: Frequency of answers regarding sleep hygiene and the use of fatigue countermeasures

Of particular interest and concern is the large proportion of “Never” or “Rarely” answers in Figure 2. For example, for Survey Item 3B, 73.9% of the respondents reported that their unit never or rarely encouraged or monitored naps, while 66.7% of respondents reported that their unit never or rarely designated dark or quiet areas for rest (Survey Item 3C). Half of the respondents (50%) answered never or rarely to Survey Item 3D, indicating that most units may have not have openly addressed issues of sleep hygiene.

We summarized the responses to the sleep hygiene statements by combining the answers to Survey Items 3A to 3D. Since the response anchors to each statement were the same, we assigned each response anchor with a value (“No basis to judge” = 0, “Never” = 1, “Rarely” = 2, “Occasionally” = 3, “Sometimes” = 4, “All the time” = 5). The point values

for each participant were summed across Survey Items 3A to 3D, giving each participant an overall score. These scores ranged from 4 (the minimum value when all answers were “Never”) to 20 (the maximum value when all answers were “All the time”). If a respondent answered “Rarely” to all four items, the overall score would be 8; whereas a participant responding “Occasionally” to all four items would result in a score of 12. Respondents indicating “Sometimes” to all four items had a score of 16. Higher scores indicate that the unit was more attentive to sleep hygiene while lower scores represent less attention was paid to unit sleep hygiene.

Not all that surprising, the results showed that participants’ sleep hygiene rating was related to whether or not they were briefed on a sleep management plan during their most recent deployment ( $F_{1,44} = 2.6895$ ,  $p=0.1$ ). Units that gave sleep plan briefings also engaged in other fatigue management practices. Figure 3 shows the average sleep hygiene rating by sleep plan briefing status.

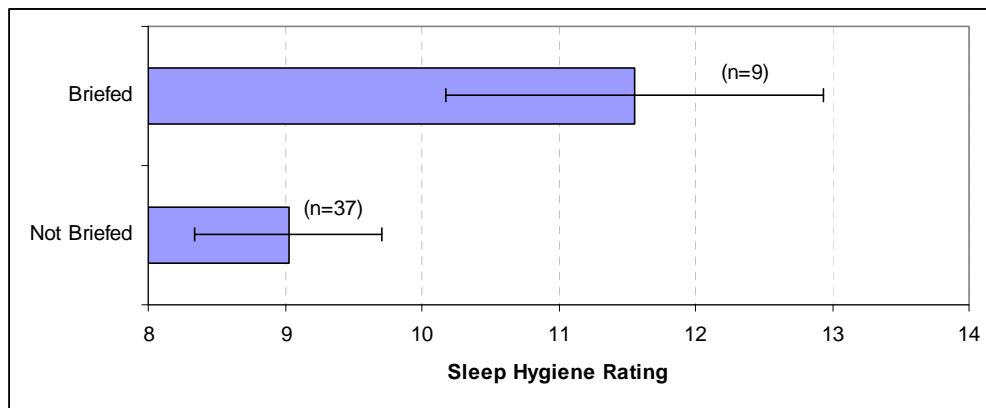


Figure 3: Sleep hygiene rating versus sleep plan briefing status. Horizontal bars indicate the standard deviations of the Sleep Hygiene Rating for the two Sleep Plan Briefing groups.

Figure 4 shows the frequency of the overall sleep hygiene rating depending on whether or not the participants had been briefed on a sleep plan.

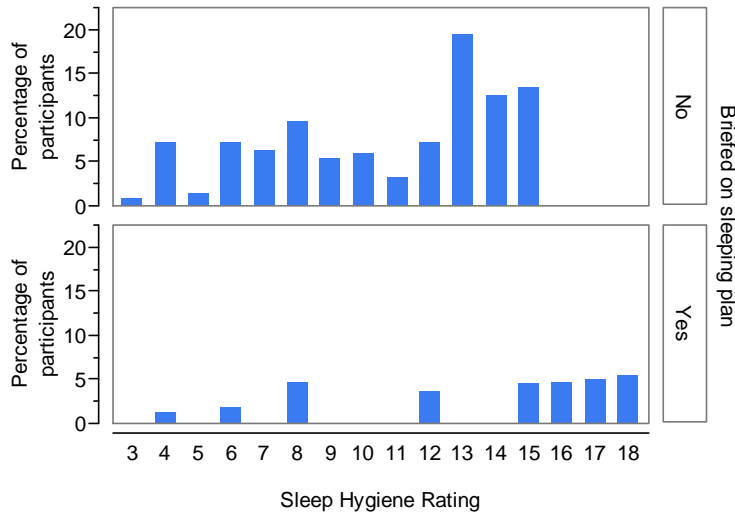


Figure 4: Frequency of Overall Sleep Hygiene Rating for participants who had been or had not been briefed on a sleep plan. Higher ratings indicate better sleep hygiene.

It is interesting to note that although those participants who report being briefed on a sleep plan had generally higher overall sleep hygiene ratings, three members of that group (44% of those who had been briefed) reported very low overall sleep hygiene ratings. The specific type of unit to which these individuals was assigned is unknown.

### 3.1. Overall Unit Fatigue and Sleep Management

The next section asked respondents to rate their agreement with the statements that “fatigue was a problem” in their unit (Survey Item 4A), and that their unit “did a good job managing sleep routines” (Survey Item 4B). While we were not able to collect objectively determined measures of sleep in these deployed units, these subjective answers indicate individual assessments of fatigue severity and sleep management. Figure 5 shows the responses to Survey Item 4A, “Fatigue was a problem in my unit.” A majority of respondents (over 55%) agreed or strongly agreed that fatigue was a problem in their unit.

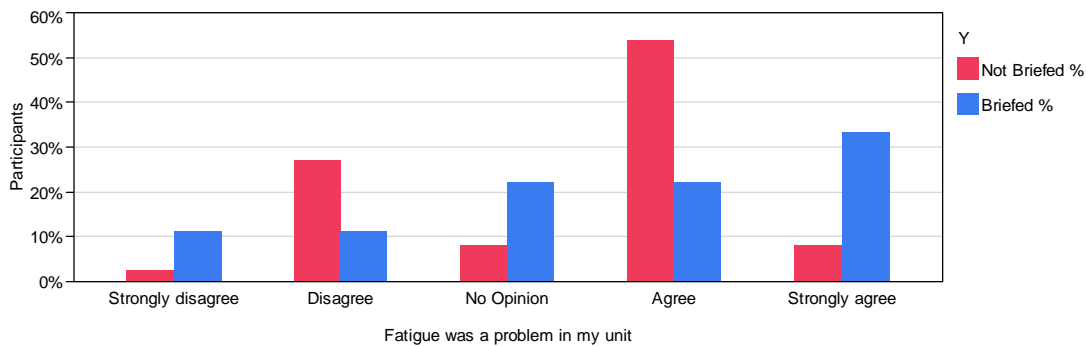


Figure 5: Frequency of responses to Survey Item 4A (“Fatigue was a problem in my unit”) versus whether participants had been briefed on a sleeping plan.



Figure 6 shows the responses to Survey Item 4B (“My unit did a good job managing sleep routines.”) Nearly two-thirds of participants (66%) who were briefed on a sleep plan agreed or strongly agreed that their unit did a good job managing sleep routines. This percentage is in stark contrast to the responses of participants who did not receive sleep plan briefings. Only 24.3% of those who did not receive a sleep plan briefing agreed that their unit did a good job managing sleep routines. Receiving a sleep plan briefing during deployment was significantly associated with the participants’ evaluation of whether their unit managed sleep routines well ( $F_{1,43} = 9.0378$ ,  $p=0.004$ ).

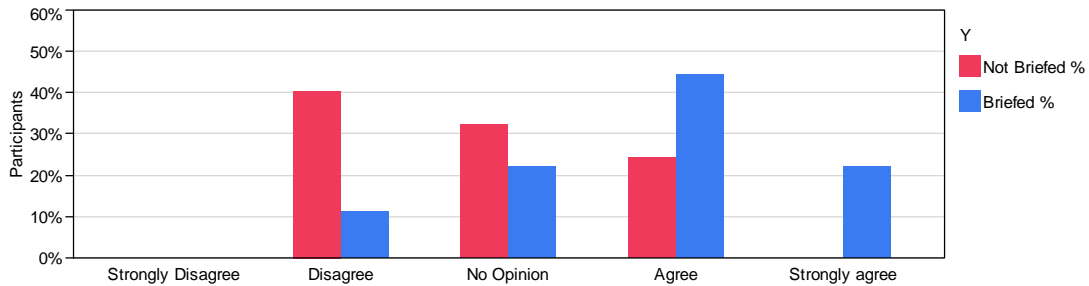


Figure 6: Frequency of answers to Survey Item 4B (“My unit did a good job managing sleep routines”) versus whether participants had been briefed on a sleep plan.

### 3.2. *Operational Tempo (OPTEMPO)*

Participants were asked to estimate the percentage of time during their last deployment when they were at high, moderate, or low Operational Tempo (OPTEMPO) (Survey Item 5). Nearly half (46.7%) of the time, participants reported that their units were in high OPTEMPO, contrasted with 36.1% of the time in moderate OPTEMPO and 17.2% of the time in low OPTEMPO. The frequency of their responses is shown in Figure 7.

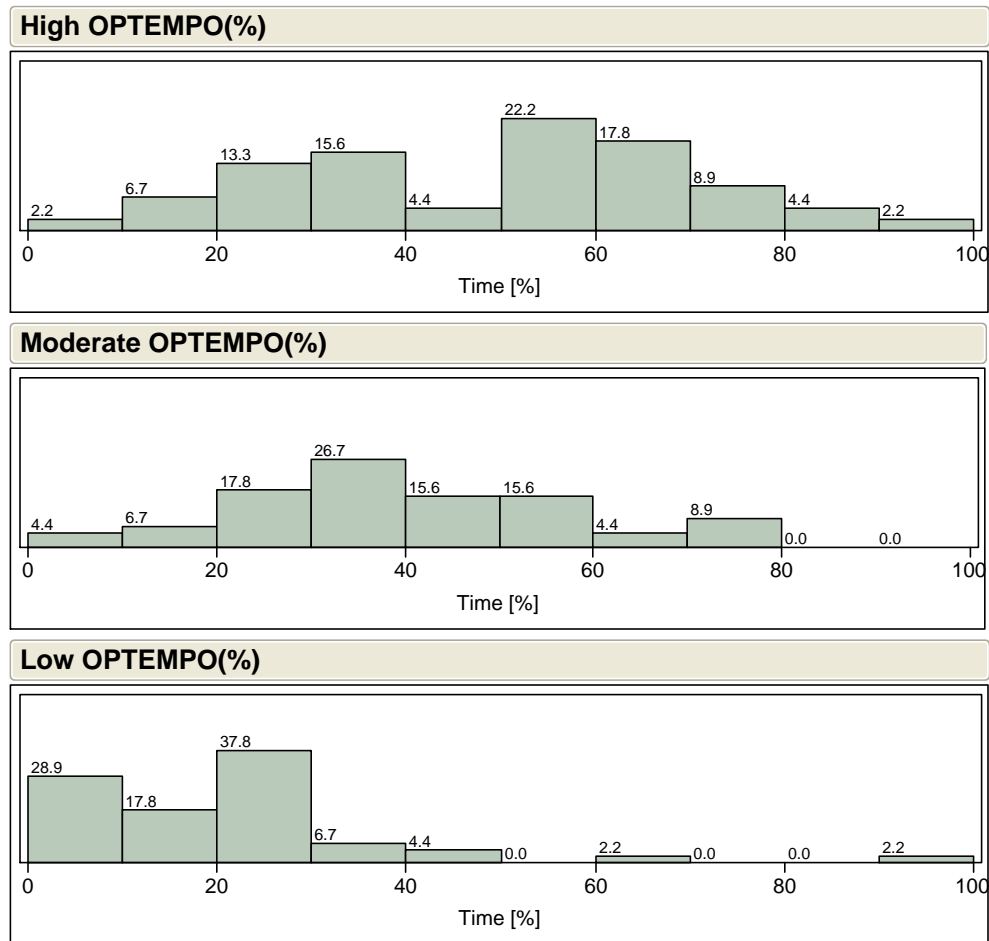


Figure 7: Percentage of answers to Survey Item 5 (“Estimate the percentage of time during your last deployment when you were at high, moderate, or low OPTEMPO.”)

For each OPTEMPO level, participants reported the average amount of daily sleep they received (Survey Item 6). Results showed that reported daily sleep varies with OPTEMPO ( $F_{2,122} = 69.3067$ ,  $p < 0.0001$ ), that is, the higher the OPTEMPO, the less sleep participants received (Low=7.8 hrs, Moderate=6.1 hrs, High=4.0 hrs). Figure 8 shows the sleep amounts for the three OPTEMPO levels.

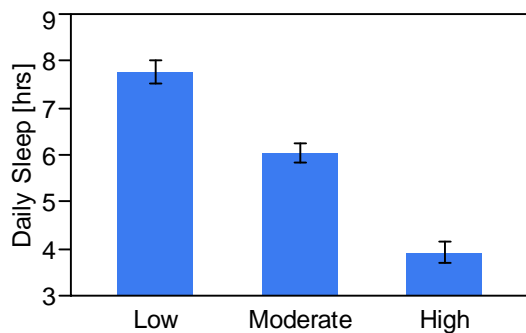


Figure 8: Daily reported sleep by OPTEMPO category.

Reported daily sleep was also related to the overall sleep hygiene rating, which may reflect the degree and extent to which participants were able to implement sleep hygiene practices while in the field. This association between daily sleep and overall sleep hygiene rating was significant only at High and Moderate OPTEMPO levels (High:  $F_{1,42} = 6.1292$ ,  $p=0.0174$ , Moderate:  $F_{1,41} = 6.5587$ ,  $p=0.0142$ ). One possible explanation for this result is that those respondents whose units had a high overall sleep hygiene rating (meaning, the unit was implementing measures in order to increase personnel sleep time) received more sleep in the field. These policies (i.e., shiftwork, napping, designation of appropriate areas for sleep, and enforcement of sleep schedules) have a positive impact in the military operational environment.

### 3.3. Frequency of Naps

Survey Item 7 asked respondents to rate the frequency with which they used naps to augment their major sleep period when they were at high, moderate, or low OPTEMPO. Figure 9 shows the frequency of these answers. Not surprisingly, increased OPTEMPO is associated with less napping, i.e., napping frequency drops off as the time available to do anything other than operations becomes more limited. This finding could account, in part, for the reduction in average daily sleep during high OPTEMPO. If one combines the two napping categories, “Never” and “Rarely”, 45% of the participants reported that during low and moderate OPTEMPO they never or rarely napped. During high OPTEMPO, this percentage reached nearly 60%.

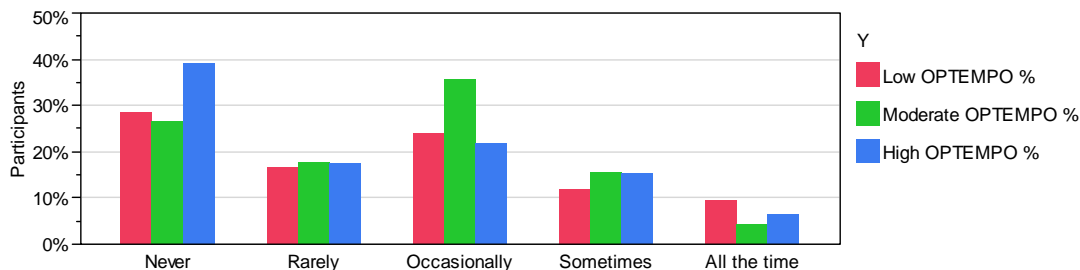


Figure 9: Frequency of answers to Survey Item 7 (“In addition to one major sleep period, I took naps to get more sleep”) versus OPTEMPO.

### 3.4. Sleep Deprivation

Survey Item 8 asked participants to rate the frequency sleep deprivation symptoms when they were at high, moderate, or low OPTEMPO. The three graphs in Figure 10 show the distribution of these responses.

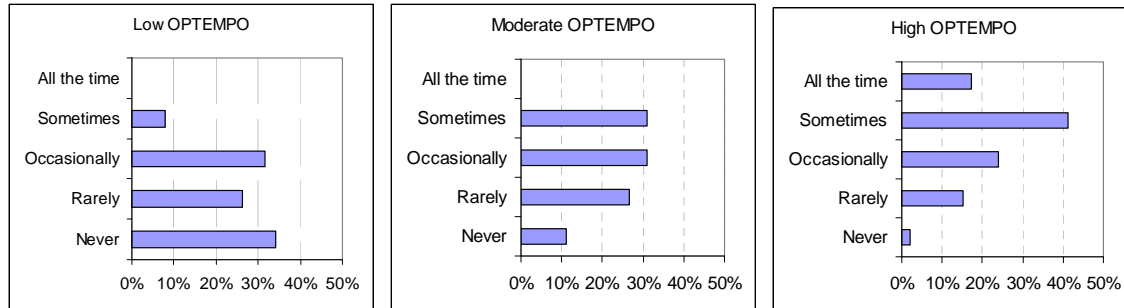


Figure 10: Distribution of responses to Survey Item 8: “How often did you feel symptoms of sleep deprivation?” by OPTEMPO.

It is clear that increasing OPTEMPO levels lead to greater severity of sleep deprivation symptoms: 53.5% of the participants reported that they rarely or never felt sleep deprivation symptoms during low OPTEMPO, 37.8% during moderate OPTEMPO and 17.4% during high OPTEMPO. An overwhelming number of respondents (82.6%) reported that they felt sleep-deprived occasionally, sometimes, or all the time while at high OPTEMPO.

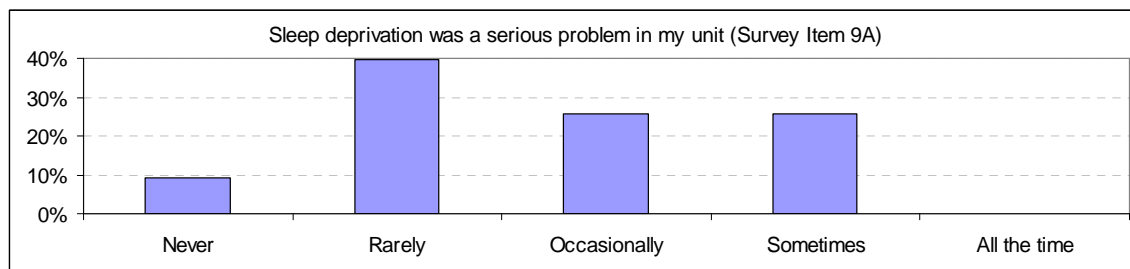
### 3.5. *Sleep deprivation and stress levels*

Participants were asked four questions that dealt with sleep deprivation and stress. These four questions were:

Over the course of the deployment:

- How often was sleep deprivation a serious problem in the unit?
- How often were you exposed to significant sources of stress?
- How often would you characterize your stress level as very high?
- Compared to your normal life, how often did you use caffeinated drinks?

The frequency of responses to these four questions is shown in Figure 11. The percentage of participants is shown by the number at the top of each bar.



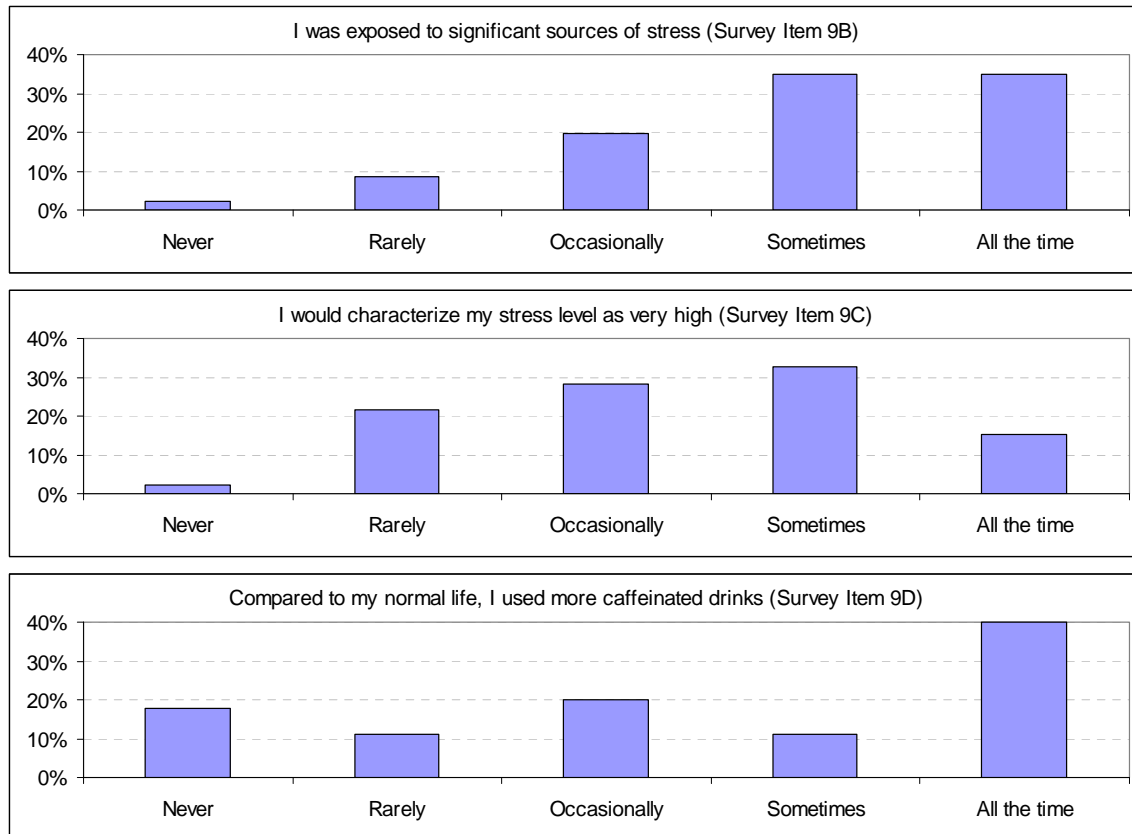


Figure 11: Frequency of answers to Survey Items 9A-9D regarding sleep deprivation and stress.

### 3.6. *Unit Sleep Patterns*

Survey Item 10 asked respondents to report on their own sleep patterns and those of subordinates, peers, and superiors. This information is shown in Figure 12. Nearly 70% of respondents reported that their superiors receive less or much less than the amount of sleep they needed. Nearly half of the respondents (47.0%) also report that subordinates receive less or much less sleep than needed. When looking at their own sleep patterns, over half (55.1%) of respondents report receiving less or much less sleep than they need.

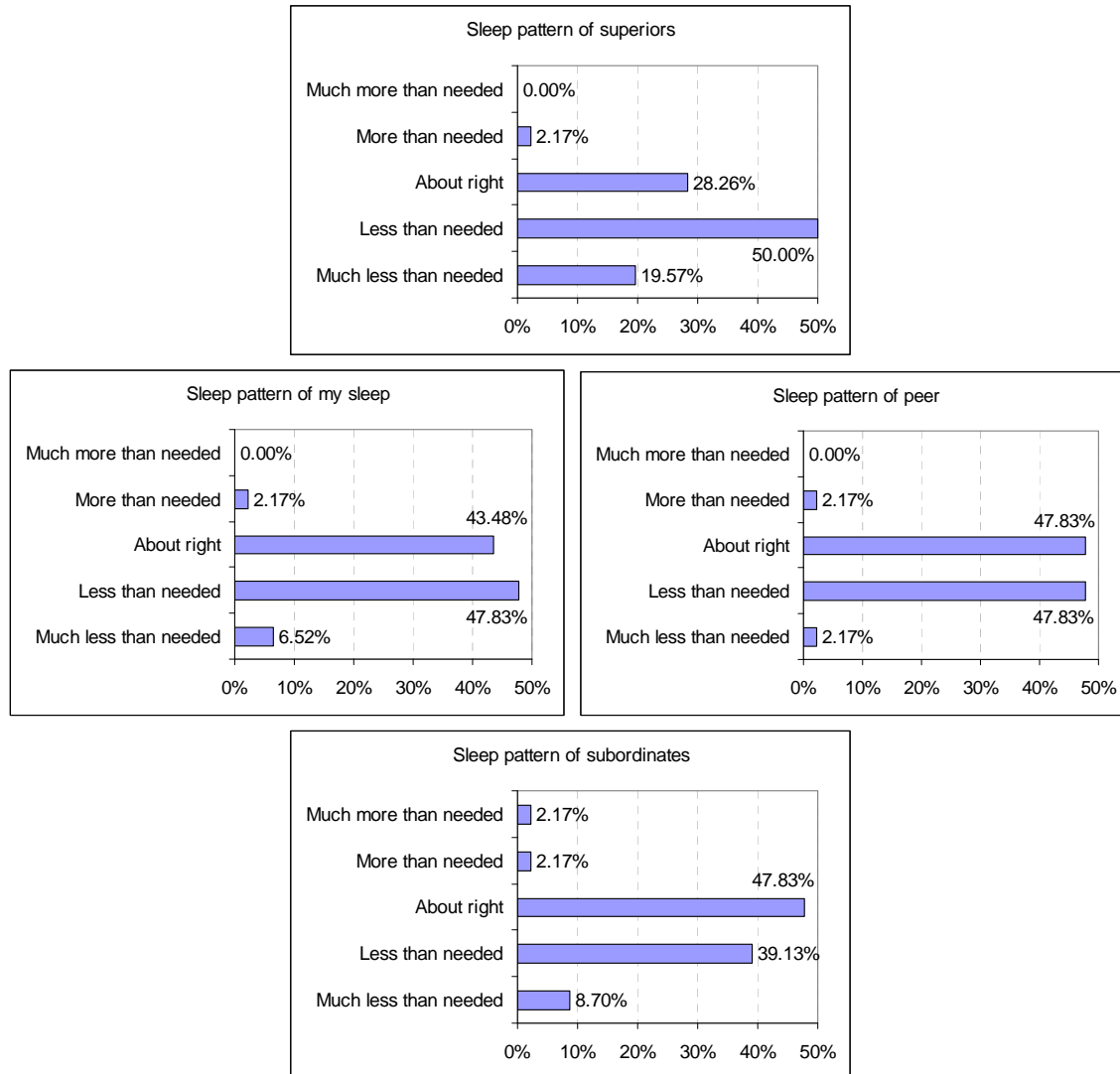


Figure 12: Frequency of answers to Survey Items 10A through 10D regarding sleep patterns of self, subordinates, peers, and superiors.

### 3.7. *Interventions to Address Sleep Issues*

Survey Item 12 was an open-ended question that asked respondents to report things that positively affected the sleep of their unit. Twelve participants noted the following factors:

- Shiftwork and rotation of individuals or squads
- Monitoring personnel performance and motivation by unit leaders
- Enforcing a work schedule, mandatory sleep periods or days off
- Employing operational risk management policies when conducting operations

### **3.8. *Negative Factors Affecting Unit Rest***

In Survey Item 13, participants were asked to report via an open-ended response any factors that adversely affected their unit. These comments from 16 respondents are summarized in the following categories:

- Heat stress
- Working long duty hours and/or non-optimized rotations
- Lack of soldiers' re-fit opportunities
- Increased workload due to reduced manning
- Commitments other than conducting operations
- High OPTEMPO
- Difficulty in scheduling activities
- Poor management of personnel

## **4. Discussion**

This study indicates that an alarming percentage (80%) of participants were not briefed on sleep management planning even though sleep plan briefings are mandatory US Army policy. This survey addressed the most recent deployment for respondents; however, the overwhelming number of participants who did not receive a briefing on sleep management demonstrates an unacceptable lack of attention to sleep hygiene by field commanders. The findings from this survey indicate that this figure has dropped even lower than that reported by Dohoney (2004) pointing to the possibility that commanders address sleep management issues even less now than at the beginning of the War on Terror. The findings from this survey reveal that a significant number of participants failed to implement a number of fairly basic sleep and fatigue management practices (e.g., encouraging napping, designating dark and quiet places to sleep).

The amount of daily sleep reported by respondents to our survey is significantly lower than the recommended requirement for eight hours of sleep per day. This result is in keeping with results from other studies conducted in Southwest Asia which reported sleep issues in US Army and Aviation (Dohoney, 2004; N.L. Miller, L.R., & Matsangas, 2007). For a review of fatigue in military operational environments refer to Miller, Matsangas and Shattuck (2007).

In general, it appears that briefing on a sleep management plan during a deployment influences better sleep practices and increased sleep hygiene in the field. Nevertheless, the fact that a significant number of the participants (44%) reported low overall sleep hygiene ratings may be attributed to two reasons. First, this may be a symptom of the military culture that encourages stoic self-denial (Shay, 1998; Davenport, 2007). Second, it may be evidence that effective training in sleep and fatigue management needs to be emphasized even more to bring results.

## 5. References

- Belenky, G. (1997). Sleep, Sleep Deprivation and Human Performance in Continuous Operations.
- Belenky, G., Wesensten, N. J., Thorne, D. R., Thomas, M. L., Sing, H. C., Redmond, D. P., et al. (2003). Patterns of Performance Degradation and Restoration During Sleep Restriction and Subsequent Recovery: A Sleep Dose-Response Study. *Journal of Sleep Research*, 12, 1-12.
- Davenport
- Dawson, D., & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature*, 388, 235.
- Dement, W.C. and Vaughan, C. (2000). The Promise of Sleep
- Doheney, S. W. (2004). *Sleep logistics as a force multiplier: An analysis of reported fatigue factors from Southwest Asia Watfighters*. Master's Thesis. Naval Postgraduate School, Monterey, California.
- Miller, N. L., Shattuck, L.G., & Matsangas, P. (2007). Effect of shiftworking on sleep attributes in operational environment: lessons from Iraq campaign (pp. 14): Naval Postgraduate School Technical Report NPS-OR-07-001.
- Miller, N. L., Matsangas, P., & Shattuck, L. G. (2007). Fatigue and its Effect on Performance in Military Environments. In P. A. Hancock & J. L. Szalma (Eds.), *Performance under Stress* (pp. 400): Ashgate Publications.
- Orne, M. T. (1962). On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. *American Psychologist*, 17(11), 776-783.
- Shay, J. (1998). Ethical Standing for Commander Self-Care: The Need for Sleep. *Parameters*, 28(2), 93-105.
- Van Dongen, H. P. A., Maislin, G., Mullington, J. M., & Dinges, D. F. (2003). The Cumulative Cost of Additional Wakefulness: Dose-Response Effects on Neurobehavioral Functions and Sleep Physiology from Chronic Sleep Restriction and Total Sleep Deprivation. *Sleep*, 26(2).